ENTOMOLOGY.—*Type specimens of mosquitoes in the United States National Museum: VI, Miscellaneous genera, addenda, and summary.*[1]

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This is the final paper of this series, and after dealing with the genera not treated in the first five parts, we offer a few additions and corrections, and a tabulation of the genera and species treated.

The introductory remarks in the first paper of this series, particularly those on early, possibly questionable holotypes, also apply to this one. Following our treatment of nominal taxa in each genus, we list those in the collection based on unique specimens or for which holotypes were clearly designated.

Genus **Aedomyia** Theobald

Aedeomyia catasticta Knab, Ent. News **20:** 387. 1909.

Three female and four male syntypes of this species are in the collection. We select as lectotype a female labeled "Thru Miss Ludlow/Samal, Bataan, P. I./Type No. 12,627 U.S.N.M./*Aedeomyia catasticta* Knab."

Genus **Ayurakitia** Thurman

Ayurakitia griffithi Thurman, 1954. Holotype.

Genus **Culiseta** Felt

Theobaldia alaskaensis Ludlow, Can. Ent. **38:** 326. 1906.

The five female and one male syntypes of this species are in the collection under two different type numbers (3359 and 27807). We select as lectotype the male bearing the labels "Ft. Egbert, Eagle, Alaska, 2 June 06/Type No. 3359 U.S. N.M./*Theobaldia alaskaensis* Ludlow." The terminalia are mounted on slide no. 222.

Culiseta dugesi Dyar and Knab, Proc. Biol. Soc. Washington **19:** 134. 1906.

The five syntype females of this species are in the collection. We select as lectotype one bearing the labels "Guanajuato, Mex. 20 Jan 05/A. Duges Coll./Type No. 9962 U.S.N.M./*Culiseta dugesi* D & K. Type."

Culex dyari Coquillett, Journ. New York Ent. Soc. **10:** 192. 1902.

The three female and one male syntypes of this species are in the collection, all bearing the labels "Center Harbor, N. H./Collection Dr. H. G. Dyar/Type No. 6700 U.S.N.M." We select as lectotype the male, with terminalia unmounted.

Culiseta maccrackenae Dyar and Knab, Proc. Biol. Soc. Washington **19:** 134. 1906.

The one male and four female syntypes of this species are in the collection. We select as lectotype the male, labeled "L. S. Jr. U. Lot 30, Sub. 3/Stan.U.Cal. 23 Jun 1903/Type No. 9961 U.S.N.M./*Theobaldia annulata* Meig. California I. McC. Col." The terminalia are mounted on slide no. 221.

Culex melanurus Coquillett, Journ. New York Ent. Soc. **10:** 193. 1902.

This species was described from two females and two males. There are seven specimens in the collection from the type locality collected by Dyar but none of them bears a type label. Two specimens bear Coquillett's determination label and these, at least, are probably syntypic. We select as lectotype the male of these two, bearing the labels "Iss. VIII.2 ⁄20/Center Harbor, N. H./Collection Dr. H. G. Dyar/See Slide No. 20/*melanurus*." The terminalia are on slide no. 20.

Culicella (*C.*) *parodites* Dyar, Mosquitoes of the Americas: 244. 1928.

The three male and one female syntypes of this species are in the collection. We select as lectotype the male, labeled "Saxesville, Wis. VI.23.09/B. K.

[1] Earlier papers of this series appeared in this JOURNAL **45:** 282–289. 1955; **46:** 213–228, 276–280. 1956; **47:** 42–59, 117–126. 1957.

[2] Studies upon which this paper is based were conducted under an exchange of funds from the Office of Naval Research (Biological Science Division) to the Smithsonian Institution. The opinions or assertions contained here are the private ones of the writers and are not to be construed as official or reflecting the views of the Navy Department or Naval Service at large.

Miller Coll./Slide 735/Type U.S.N.M." The slide bears the terminalia.

Culiseta siberiensis Ludlow, Ins. Insc. Mens. **7:** 151. 1919 [1920].

This species was described from 24 females collected in three localities in Siberia. Twenty-three of these are in the collection, and nine bear type labels. It is not possible to tell the type locality of any of these bearing the red type labels, since they are either unlabeled or have all three localities on the label. We select as lectotype a female labeled "Type No. 27808 U.S.N.M./*Culiseta siberiensis* Ludl. Mostovoi, Selenga, Verkhne Udinsk, Siberia Type (1)."

Holotypes, designated or unique:

Culex inornatus Williston, 1893.
Culiseta (*Culicella*) *nipponica* LaCasse and Yamaguti, 1950.

Genus **Deinocerites** Theobald

Dinomimetes epitedeus Knab, Journ. New York Ent. Soc. **15:** 120. 1907.

The two female and one male syntypes of this species are in the collection, all bearing the labels "Port Limon, C. R./Type No. 10291 U.S.N.M." We select as lectotype the male, bearing the additional labels, "No. 344a See F. Knab's Entom. Notes/See Slide No. 286." The terminalia are on the slide.

Deinocerites cancer var. *melanophylum* Dyar and Knab, Journ. New York Ent. Soc. **15:** 200, 1907.

The nine syntypes of this species are in the collection, each bearing the label "Type No. 10865 U.S.N.M." We select as lectotype a male, with the additional labels "213/Colon, Panama/Collected by August Busck/*Deinocerites melanophilum* [sic] D. & K. Type."

Deinocerites pseudes Dyar and Knab, Smithsonian Misc. Coll. **52:** 260. 1909.

The nine syntypes of this species are in the collection, each bearing the label "Type No. 12053 U.S.N.M." We select as lectotype a female, bearing the additional labels "378/Ancon, Canal Zone, Panama/A. H. Jennings Collector."

Dinanamesus spanius Dyar and Knab, Smithsonian Misc. Coll. **52:** 259. 1909.

The two syntypes of this species are in the collection. We select as lectotype the female, bearing the labels "69/A. H. Jennings Collector/Type No. 12052 U.S.N.M./*Dinanamesus spanius* D. & K. Type." Data for Jennings number 69 are, "Corazal, Panama, Dec. 11, 1907, from crab hole."

Deinocerites tetraspathus Dyar and Knab, Smithsonian Misc. Coll. **52:** 260. 1909.

The two syntype females are in the collection. We select as lectotype the one bearing the labels "Bluefields, Nicaragua/Type No. 12109 U.S. N.M./See Slide No. 472." The terminalia are mounted on the slide.

Deinocerites troglodytus Dyar and Knab, Smithsonian Misc. Coll. **52:** 260. 1909.

Eighteen of the original 20 specimens of this species are in the collection. Only one bears a type label, and this we consider the holotype. The labels on this female specimen are "Trinidad, W. I. June/Aug. Busck Collector/Type No. 12128 U.S.N.M."

Deinocerites monospathus Dyar, 1925. Holotype, unique.

Genus **Ficalbia** Theobald

Ludlowia minima Theobald, Can. Ent. **39:** 413. 1907.

The syntype pair of this species are in the collection. We select as lectotype the female, bearing the labels, "Type No. 27800 U.S.N.M./*Ludlowia minima* Ludlow. Cudarangan, Mindanao, P. I. January. Type C.S.L./Slide 56.III.1."

Holotypes, designated or unique:

Aedes clavirostris Stone and Bohart, 1944.
Ficalbia flavens King and Hoogstraal, 1946.
Oreillia luzonensis Ludlow, 1905.
Ficalbia modesta King and Hoogstraal, 1946.

Genus **Heizmannia** Ludlow

Heizmannia scintillans Ludlow, 1905. Holotype, unique.

Genus **Hodgesia** Theobald

Hodgesia ampyx Dyar, Ins. Insc. Mens. **8:** 176. 1920.

The two syntype females of this species are in the collection. Both are in poor condition, but we select as lectotype the better one of the two. It

bears the labels "Acc. No. 18399 Coll. of Agr. Univ. P. I./Type No. 23716 U.S.N.M./*Hodgesia. ampyx* Dyar. Type."

Hodgesia niveocaputis Ludlow, Psyche **18:** 130. 1911.

The five syntype females of this species are in the collection, each bearing the label "Type No. 27798 U.S.N.M." One only bears additional labels, and this we select as lectotype. The labels are "Wing slide/*Hodgesia niveocephala* [sic] Ludl. Fort Pikit, Mindanao, P. I. Type." The slide is in the collection.

Genus **Mansonia** Blanchard

Taeniorhynchus aureosquammatus Ludlow, Can. Ent. **4:** 234. 1909.

The collection contains five specimens labeled by Ludlow either as *Taeniorhynchus aureosquammatus* or *Oculeomyia ? aureosquammosa*, as well as a number of others with no labels. Only one bears a type label (unnumbered) and we select this as lectotype. This female bears the label "*Oculeomyia ? aureosquammosa* [sic] n. sp., Parang, Nov. 1908."

Mansonia chrysogona Knab, Ent. News **20:** 386. 1909.

The two female and one male syntypes of this species are in the collection. We select as lectotype the male, labeled "Parang, Mindanao 31. May 06/See Slide No. 488/Type No. 12,626 U.S. N.M." The terminalia are on the slide.

Taeniorhynchus coticula Dyar and Knab, Journ. New York Ent. Soc. **15:** 101. 1907.

The two syntype females of this species are in the collection bearing the labels "USDA No. 10417/Bocas d Toro, Pan. 25 Sept. 03/P. Osterhout Collector/Type No. 10281 U.S.N.M." We select as lectotype the better of these, bearing Dyar's determination label.

Mansonia (*Coquillettidia*) *diaeretus* Dyar, Ins. Insc. Mens. **8:** 181. 1920.

The two syntype females of this species are in the collection, each bearing the label, "Type No. 23721 U.S.N.M." We select the better of these as lectotype, bearing the labels "Los Banos, P. I. 5.III.1918/*Taeniorhynchus diaeretus* Dyar Type."

Mansonia humeralis Dyar and Knab, Ins. Insc. Mens. **4:** 65. 1916.

This species was described from females and eggs. The collection contains two original females but only one bears a type label and this we consider the holotype. The labels are "H.W.B.Moore See letter Feb. 8, 1916/*M. titillans* egg cluster in tube/Type No. 20366 U.S.N.M./*Mansonia humeralis* D. & K. Type."

Taeniorhynchus nigricans Coquillett, Proc. Ent. Soc. Washington **6:** 166. 1904.

The two syntype females of this species are in the collection, each bearing the labels "Panama Apr. 18, 04/J. W. Ross/Type No. 7943 U.S. N.M." We select as lectotype the better of the two, bearing Coquillett's determination label.

Taeniorhynchus pagei Ludlow, *in* Theobald, Monograph of the Culicidae **5:** 618. 1910.

The two female and one male syntypes of this species are in the collection. Two bear an unnumbered type label only. The third, a female, bears the additional label "*Taeniorhynchus pagei*, Parang, Mindanao, P. I. Oct. Page." The original material of *aureosquammatus* and *pagei* are largely unlabeled and mixed, but we think that this specimen can be justifiably selected as lectotype of *pagei*.

Holotypes, designated or unique:

Taeniorhynchus flaveolus Coquillett, 1906.
Mansonia hypocindyna Dyar, 1918.
Mansonia indubitans Dyar and Shannon, 1925.
Mansonia (*Mansonioides*) *marquesensis* Dyar, 1925 (terminalia only).
Culex ochropus Dyar and Knab, 1907.
Bancroftia persephassa Dyar and Knab, 1909.

Genus **Orthopodomyia** Theobald

Mansonia fascipes Coquillett, Proc. Ent. Soc. Washington **7:** 182. 1905.

The collection contains two females bearing the labels "No. 338b See F. Knab's Entom. notes/R. Aranjuez, Puntarenas, C. R./Cotype No. 8296 U.S.N.M." A third is the same except that the number is 338d. There are other specimens of the same series not labeled as type, so it is impossible to say which is the fourth syntype. We select as lectotype the female bearing the label in Coquillett's hand "*Mansonia terrens* Walk."

Orthopodomyia (*O.*) *nipponica* LaCasse and Yamaguti, Mosquito Fauna of Japan and Korea II: 264. 1948.

The syntypes of this species consisted of two females and one male reared from a single larval collection. One of each sex were said to have been sent to the Museum. The collection contains two of each sex bearing identical data but from the care in labeling it is quite evident which were the two syntypes. We select the female of these two as lectotype. The only label is "*Orthopodomyia nipponica* LaCasse and Yamaguti. Female, Kyoto, Honshu, 17 November 1948. 207th M.S.D."

Holotypes, designated or unique:

Orthopodomyia alba Baker, 1936.
Orthopodomyia californica Bohart, 1950.
Mansonia phyllozoa Dyar and Knab, 1907.
Culex signifer Coquillett, 1896.

Genus **Toxorhynchites** Theobald

Toxorhynchites argentcotarsis Ludlow, Can. Ent. **38:** 367. 1906.

Four of the five female syntypes of this species are in the collection. A fifth specimen bears an unnumbered type label and Ludlow's determination and type label, but it is from Corregidor and is therefore not one of the original specimens. Of the other four, one bears a red type label with no number, two bear type no. 10254, and one type no. 27784. The one without a number carries a type label in Ludlow's hand. Type no. 27784 bears no data so that only three bear original data, and we select as lectotype the one labeled by Ludlow "*Toxorhynehites argenteotarsis* Ludl. Margosatubig, Mindanao, P. I. June & July 1906. Type C.S.L./Type No.___ U.S.N.M."

Woreesteria grata Banks, Philippine Journ. Sci. **1:** 780. 1906.

The original description of this species states, "Types ♂ of and ♀. No. 6071 in Entomological Collection, Bureau of Science, Manila, P. I. There are 18 cotypes in the collection." We can assume that Banks was using "cotype" in the sense of "paratype", so that there were a pair of syntypes selected from the others to represent the species. All the material in the Bureau of Science Collection was destroyed so that these two "types" are lost. The National Museum collection has two males and one female of the series no. 6071 cotypes. We feel that since these are of the original series and are therefore syntypic, since no holotype was originally selected, and since these are probably the only original specimens in existence, we can legitimately select one of the males as lectotype. The labels on this specimen are "Acc. No. 6071 Lot. co-type Govt. Lab. Coll./Type No. 10255 U.S.N.M./*Worcesteria grata* Banks."

Megarhinus guadeloupensis Dyar and Knab, Smithsonian Misc. Coll. **48:** 254. 1906.

The two original specimens, a male and a female, are in the collection. Only one bears a type label and this female we consider the holotype. It bears the labels "79.1/Guadeloupe, W. I. July/Aug. Busck Collector/Type No. 9956 U.S. N.M./*Megarhinus guadeloupensis* D. & K."

Megarhinus haitiensis Dyar and Knab, Smithsonian Misc. Coll. **48:** 253. 1906.

The original female and three males of this species are in the collection, all labeled "S. Frncsco Mts. S Domingo W. I. Sept. 05/Aug. Busck Collector." Only one bears a type label and this female we consider the holotype. It bears the additional labels "134.1/Type No. 9955 U.S. N.M./*Megarhinus haitiensis* D. & K."

Megarhinus moctezuma Dyar and Knab, Smithsonian Misc. Coll. **48:** 251. 1906.

Of the original 16 males and 2 females of this species, two males are missing. Only one specimen bears a type label so this we consider the holotype. It bears the labels "No. 3380 See F. Knab's Entom. notes/R. Aranjuez, Puntarenas, C. R./Type No. 9953 U.S.N.M./*Megarhinus moctezuma* D. & K."

Megarhinus rutila Coquillett, Can. Ent. **28:** 44. 1896.

The original material was said to consist of three males and five females from North Carolina and Georgiana, Florida. In the collection are two specimens from Georgiana, Florida, and seven labeled only "Fla." and none from North Carolina. One specimen bears a type label and this we select as lectotype. This male bears the labels "Fla/Type No. 903 U.S.N.M./*Megarhinus rutilus* Coq."

Megarhinus septentrionalis Dyar and Knab, Smithsonian Misc. Coll. **48:** 249. 1906.

One only of the 24 original specimens bears a type label, and this we consider the holotype. The labels on this male are, "Woodstock, Va. iss 24 Aug. 04/F. C. Pratt Collector/Type No. 9952 U.S.N.M./*Megarhinus septentrionalis* D. & K."

Megarhinus superbus Dyar and Knab, Smithsonian Misc. Coll. **48:** 255. 1906.

We consider the holotype to be the single specimen bearing a type label. This male bears the labels "Trinidad, W. I./F. W. Urich Collector/16-9/Type No. 9957/*Megarhinus superbus* D. & K." The terminalia are mounted on a slide.

Megarhinus trinidadensis Dyar and Knab, Smithsonian Misc. Coll. **48:** 252. 1906.

One only of the five original specimens bears a type label and this female we consider the holotype. It bears the labels "Trinidad, W. I./F. W. Urich Collector/B3.2/Type No. 9954 U.S. N.M./*Megarhinus trinidadensis* D. & K."

Holotypes, designated or unique:

Megarhinus gigantulus Dyar and Shannon, 1925.
Megarhinus hypoptes Knab, 1907.
Megarhinus iris Knab, 1913.
Megarhinus lewaldii Ludlow, 1904.
Megarhinus nepenthis Dyar and Shannon, 1925.

Genus **Uranotaenia** Lynch Arribálzaga

Uranotaenia calosomata Dyar and Knab, Journ. New York Ent. Soc. **15:** 200. 1907.

The five syntypes, two females and three males, of this species are in the collection, three with type labels, two without. We select as lectotype a male bearing the labels "23.8/Tabernilla, Canal Zone, Panama/collected by August Busck/ Type No. 10866 U.S.N.M." A portion of the larval skin of this specimen is mounted on a slide.

Uranotaenia clara Dyar and Shannon, Ins. Insc. Mens. **13:** 68. 1925.

The syntype pair of this species is in the collection. We select as lectotype the male, bearing the labels "2150/Type No. 28103 U.S.N.M./ Ludlow Barracks, Mindanao, P. I." The terminalia are on slide no. 2150.

Uranotaenia coatzacoalcos Dyar and Knab, Journ. New York Ent. Soc. **14:** 186. 1906.

This species was described from the larva only, collected at Santa Lucrecia, Mexico. The only original material found consists of two larval head capsules and fragments of the rest of the skins. The material is so inadequate that there is no point in selecting a lectotype.

Uranotaenia cooki Root, Journ. Parasitol. **23:** 98. 1937.

Root selected one of each sex from a series of five specimens to be types of this species. These were supposedly deposited in the National Museum collection. All that we find in the collection is a slide labeled "*Uranotaenia cooki* Root (type) Port-au-Prince, Haiti, Feb. 11, 1932, Dr. S. S. Cook/Type No. 50375 U.S.N.M." This contains the fore leg, portion of another tarsus, and the terminalia. It is quite certain that this is the specimen figured by Root. We select this slide as lectotype.

Uranotaenia caeruleocephala var. *lateralis* Ludlow, Can. Ent. **37:** 385. 1905.

The four syntype females of this species are in the collection bearing either numbered or unnumbered type labels. We select as lectotype one bearing the labels "Type No. 27786 U.S.N.M./ *Uranotaenia caeruleocephala* Theob. var. *lateralis* Lud. Cottabato, Mindanao, P. I. June. Type C.S.L."

Uranotaenia ludlowae Dyar and Shannon, Ins. Insc. Mens. **13:** 68. 1925.

Twenty of the original 22 syntype females of this species are in the collection. We select as lectotype one bearing the labels "Type No. 28077 U.S.N.M./Ludlow Barracks, Mindanao."

Uranotaenia urania Shannon and Del Ponte, Rev. Inst. Bact. **5:** 83. 1928.

The syntype pair of this species is in the collection. We select as lectotype the male, bearing the labels "Resistencia, Chaco 20.2.27/2355/ *Uranotaenia urania* S. & D.P." The terminalia are mounted on slide no. 2355.

Holotypes, designated or unique:

Uranotaenia barnesi Belkin, 1953.
Uranotaenia basalis Howard, Dyar, and Knab, 1913.
Uranotaenia briseis Dyar, 1925.
Uranotaenia capitis Shannon and Del Ponte, 1928.
Uranotaenia civinskii Belkin, 1953.
Uranotaenia pulcherrima var. *elnora* Paterson and Shannon, 1927.
Uranotaenia fimbriata King and Hoogstraal 1947.
Uranotaenia hystera Dyar and Knab, 1913.
Uranotaenia incognita Galindo, Blanton, and Peyton, 1954.
Uranotaenia innotata Dyar and Shannon, 1925.
Uranotaenia nanseica Bohart and Ingram, 1946.

Uranotaenia neotibialis King and Hoogstraal, 1947.
Uranotaenia orthodoxa Dyar, 1921.
Uranotaenia paludosa Galindo, Blanton, and Peyton, 1954.
Pseudouranotaenia parangeneis Ludlow, 1909.
Uranotaenia setosa King and Hoogstraal, 1947.
Uranotaenia sexaueri Belkin, 1953.
Uranotaenia solomonis Belkin, 1953.
Uranotaenia stonei Bohart and Ingram, 1946.
Uranotaenia subtibioclada King and Hoogstraal, 1947.
Uranotaenia syntheta Dyar and Shannon, 1924.
Uranotaenia telmatophila Galindo, Blanton, and Peyton, 1954.
Uranotaenia tibioclada King and Hoogstraal, 1947.
Uranotaenia trapidoi Galindo, Blanton, and Peyton, 1954.
Pseudouranotaenia triangulata Ludlow, 1908.
Uranotaenia typhlosomata Dyar and Knab, 1907.
Uranotaenia wysockii Belkin, 1953.

Genus **Zeugnomyia** Leicester

Holotypes:

Zeugnomyia aguilari Baisas and Feliciano, 1953.
Zeugnomyia fajardoi Baisas and Feliciano, 1953.
Zeugnomyia lawtoni Baisas, 1946.

ADDITIONS AND CORRECTIONS, PARTS I TO V

In the first five parts of this series a few species were omitted for one reason or another, and a few errors were made and since discovered. We deal with these at the present time.

Aedes diantaeus Howard, Dyar, and Knab.

The name was first validated in vol. 2, fig. 167, of "Mosquitoes of North and Central America and the West Indies," 1913, not vol. 4, 1917, as given in Part II.

Aedes draconarius Dyar, Ins. Insc. Mens. **10:** 194, 1922.

This species was described from two females and four males, one pair being in the U. S. National Museum, and the rest returned to the Museum of Natural History in Paris. According to Dr. Séguy, the Paris Museum has two females, one labeled as type by Dyar, the other a "cotype" without type label. Since only one female was returned to Paris by Dyar it is probable that the "cotype" was not actually seen by Dyar. There are then three syntypes in existence, consisting of a pair of specimens in the U. S. National Museum entered in the type catalogue by Dyar under type No. 25765, and a female in the Paris Museum. We select as lectotype the female of the two syntypes in the U. S. National Museum. It bears the labels "St. Laurent du Maroni, Guyane fr. Dr. E. Brimont 1909, Institut Pasteur/Type No. 25765 U.S.N.M."

Aedes euiris Dyar, Ins. Insc. Mens. **10:** 193. 1922.

The three female syntypes of this species were distributed between the Paris Museum (2) and the U. S. National Museum, one of the former being labeled "cotype." Dr. Séguy informs us that the one labeled "cotype" by Dyar is in the Paris Museum, the second specimen not being found. We select as lectotype the female in the U. S. National Museum labeled "Colombia Dr. F. A. Miller/Type No. 25763 U.S.N.M./*Aedes euiris* Dyar Type."

Anopheles neivai Howard, Dyar, and Knab.

This name was first validated in vol. 2, pl. 41, fig. 8, and fig. 461, of "Mosquitoes of North and Central America and the West Indies," 1913, not vol. 4, 1917, as stated in Part III.

Aedes palustris var. *pricei* Dyar.

This was incorrectly placed alphabetically in Part II, p. 223. It should have come after *Culex pretans* on. p. 224.

Aedes (*Soperia*) *pseudodominicii* Komp, Proc. Ent. Soc. Washington **38:** 75. 1936.

The type of this species was to have been placed in the U. S. National Museum Collection but it has not been found and is probably lost.

Aedes (*Howardina*) *stenei* Thompson, 1956.

The holotype of this species has been placed in the collection since the publication of Part II.

SUMMARY

In a series of six papers we have treated the type material of 910 named specific, subspecific, or varietal taxa of mosquitoes in 27 genera. Of these there are 875 taxa for which either a holotype or a lectotype is in the U. S. National Museum collection.

The following alphabetical list of genera shows the part or parts of the series of papers in which each was treated.

Genus	*Part*
Aedeomyia	VI
Aedes	II, VI
Anopheles	III, VI
Armigeres	I
Ayurakitia	VI
Chagasia	III
Culex	IV
Culiseta	VI
Deinocerites	VI
Ficalbia	VI
Haemagogus	I
Heizmannia	VI
Hodgesia	VI
Limatus	V
Malaya	V
Mansonia	VI
Orthopodomyia	VI
Phoniomyia	V
Psorophora	I
Sabethes	V
Topomyia	V
Toxorhynchites	VI
Trichoprosopon	V
Tripteroides	V
Uranotaenia	VI
Wyeomyia	V
Zeugnomyia	VI

CRYSTAL CHEMISTRY OF TOOTH AND BONE MINERAL

Using the techniques of chemical crystallography, scientists at the National Bureau of Standards are developing new information on the nature of calcified tissue. The Bureau's dental research laboratory has synthesized pure single crystals of hydroxyapatite[1]—the prototype of the main mineral constituent in teeth and bone. Both the synthetic and naturally occurring apatites have been analyzed by X-ray diffraction and infrared absorption spectroscopy.[2] Results of the study may lead to a better understanding of the function of calcified tissue in the body and eventually perhaps to new methods of treating diseased teeth and bone.

The current investigations are being conducted by A. S. Posner, research associate, American Dental Association; A. F. Diorio, a guest worker from the Walter Reed Army Medical Center; and A. Perloff of the Bureau staff. The NBS constitution and microstructure laboratory is assisting in the work, and the National Institutes of Health and the Army Medical Center have cooperated on specific projects.

APATITE MINERALS

The apatites are the most abundant of the phosphate minerals. The name "apatite" was derived from the Greek word meaning "to deceive" since the mineral was often confused with others like aquamarine or amethyst. Pure hydroxyapatite is a chemical rarity having the formula $Ca_{10}(PO_4)_6(OH)_2$. However, the mineral known as hydroxyapatite always contains a certain portion of fluoride ions (F^-) replacing the hydroxyl ions (OH^-).

Previous analyses had shown that tooth mineral is some form of hydroxyapatite mixed with other phases. Thus the study of the calcified tissue in teeth ties in with that of the apatite family of minerals. Besides providing a better understanding of the structure and function of dental enamel, the data developed should be useful in a number of other fields including mineralogy, crystallography, basic chemistry, and physics.

The crystallographic studies at the Bureau indicate that the major constituent of tooth mineral may be a calcium-deficient hydroxyapatite[3]. Chemical analyses of sound human teeth show they contain less than 10 calcium atoms for every 6 atoms of phosphorus. In other words, there is not enough calcium to provide the 10Ca/6P ratio found in perfect hydroxyapatite. However, X-ray and index of refraction studies of teeth definitely indicate the presence of apatite. The evidence taken together suggests the presence in teeth of defect apatites in which some of the calcium ions are missing from certain struc-

[1] For further technical details, see *Preparation of pure hydroxyapatite crystals*, by A. Perloff and A. S. Posner, Science **48**: 383. 1956.

[2] *Infrared study of the carbonate in bone, teeth, and fracolite*, by A. S. Posner and G. Durckaerts, Experientia **10**: 424. 1954.

[3] *Apatites deficient in divalent cations*, by A. S. Posner and A. Perloff, Journ Research Nat. Bur. Stand. **58**: 279. 1957. RP 2761.